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Plant Foods

A great deal of epidemiological evidence indicates that diets high in plant foods (fruits, vegetables, whole grains, legumes, nuts and seeds) are associated with a lower incidence of chronic diseases, such as cardiovascular disease, certain cancers, stroke, cataracts, diabetes, chronic obstructive pulmonary disease (COPD), diverticulosis, and high blood pressure. Plant foods are rich in micronutrients, (phytochemicals, antioxidants, vitamins and minerals) and fiber which are actively being investigated for their health-promoting, disease-preventing potential.

Phytochemicals

Phytochemicals are non-nutritive substances naturally occurring in plants. Phytochemicals provide plants with natural defenses against predators such as viruses and plant eating insects, or are used by plants to attract insects for fertilization. We ingest hundreds of these plant chemicals in the food we eat, yet scientists are just beginning to understand their effects on humans. Phytochemicals are classified by their biological function, although many have more than one function.

Cruciferous vegetables like broccoli, cauliflower, cabbage and brussels sprouts, have a high content of *dithiolthiones* and *isothiocyanates* which help increase the activity of enzymes involved in the detoxification of carcinogens. Cruciferous vegetables also contain *indoles*, which have been shown to block tumor production.

Onions, garlic, scallions, leeks and chives are in the *Allium* family of vegetables. Allium vegetables contain *sulfide* compounds that detoxify cancer-causing chemicals. They have an anti-bacterial action as well, inhibiting the bacterial conversion of nitrate to nitrite in the stomach, which prevents the formation of nitrosamines (a known carcinogen). Garlic has been shown to reduce the risk of heart disease by reducing serum cholesterol levels, inhibiting platelet aggregation, decreasing coagulation time and lowering blood pressure.

Legumes and whole grains contain *saponins*, which protect against colon cancer and reduce serum cholesterol levels by binding with bile acids and cholesterol in the colon. Soybeans contain phytochemicals called *protease inhibitors* that appear to increase the accuracy of DNA repair, decrease the rate of cell division or decrease the destruction of the surrounding environment of tumor cells.

Citrus fruits and juice, such as orange, grapefruit, lemon and lime, contain *coumarins* and *limonene*, which have been shown to increase the activity of

glutathione transferase, an enzyme involved in detoxification of potential carcinogens.

Antioxidants

An antioxidant is a substance in food that significantly decreases the adverse effects of free radicals. Free radicals are highly reactive oxygen and nitrogen molecules, by-products of human metabolism and environmental agents such as sunlight, pollution, and smoking. In excess, free radicals produce harmful oxidation that can damage cell membranes and cell contents, thus increasing the risk of disease. Antioxidants have multiple biological functions to prevent cell damage and reduce the risk of many diseases.

Phytochemicals, as well as vitamins and minerals, can act as antioxidants. Citrus fruits and juices are high in *vitamin C*, which protects the cell membrane and cellular DNA from oxidative damage. Vitamin C also plays a role in preserving the integrity of intracellular matrixes, which may hinder tumor growth. A high

intake of citrus fruits has been associated with reduced risk of heart attacks, possibly by reducing the oxidation of cholesterol in the arteries.

The mineral *selenium*, found in whole grains, nuts and seeds, functions as a cofactor in enzyme activity that protects against cell oxidative damage and alters the metabolism of potential carcinogens in the liver. *Vitamin E*, found in nuts, seeds, vegetable oils and whole grains, protects polyunsaturated fats in cell membranes from oxidation. It improves the oxidative performance of selenium and decreases the formation of nitrosamines in the gut.

Carotenoids are found in several different forms. Green leafy vegetables contain *lutein*, a carotenoid shown to block cellular damage by free radicals. Orange vegetables like carrots, sweet potatoes and pumpkin contain *beta-carotene* that protect against free radical damage, inhibit cell proliferation and may increase cell-to-cell communication. Tomatoes, and other deep-red fruits and vegetables, contain *lycopene*,

Table 1: Phytochemicals and Antioxidants in Foods

Phytochemicals and Antioxidants	Foods
Allyl Sulfides	Onions, garlic, leeks, chives
Capsaicin	Hot chili peppers
Carotenoids	 Sweet potato, winter squash, cantaloupe, peaches, mango, carrots, apricots, collard greens, kale, spinach Collards, spinach, kale, corn, kiwi, green grapes, green pepper, peaches, squash, broccoli, egg yolk Tomatoes and tomato-based products, watermelon, red & pink grapefruit, red peppers, guava
Flavonoids	All fruits and vegetables – the darker the color generally the more flavonoids. Includes grape juice, red wine, nuts, olives, tea, prunes, raisins
Indoles	Broccoli, cabbage, kale, cauliflower, kohlarabi, brussel sprouts, mustard greens, rutabaga, turnips
Isothiocyantates	Broccoli, cabbage, watercress, brussel sprouts, kale, dried beans and lentils, citrus fruits and juice
Phytoestrogenes	• Tofu, soy milk, and other foods made from soybeans
isoflavones	• Soy, alfalfa and clover sprouts
coumarinslignans	• Flax seed, sesame seeds, sunflower seeds, whole grains, bran of wheat, barley & rye, carrots, broccoli, asparagus, squash
Saponins	Dried beans and lentils, soybeans and soybean foods, oats, nuts
Selenium	Nuts, seeds, seafood, shellfish, red meat, chicken, eggs
Tannins	Broccoli, bok choy, blueberries, raspberries, blackberries, strawberries
Terpenes	Cherries, citrus fruits, summer squash, sweet potatoes, tomatoes, broccoli, bok choy, cabbage, soybeans and soy foods
Vitamin C	Citrus fruits and juices, berries, bell peppers, tomatoes, potatoes, guava, pineapple, papaya, cabbage
Vitamin E	vegetable oils, nuts, seeds, whole grains, salmon, egg yolks, shellfish, soybeans

an antioxidant associated with reduced risk of prostate cancer. High dietary intake of a variety of carotenoids has been associated with a lower risk of cataracts.

Phytoestrogens are antioxidants that exhibit estrogenlike activity. Isoflavones, found only in legumes (especially soybeans), are a weak estrogen that compete with more potent estrogens for binding to estrogen receptors, thus inhibiting estrogen-related cancers. This estrogen-like activity has shown reduced bone loss in postmenopausal women, which may help in the prevention of osteoporosis. Isoflavones have also been associated with reductions in heart disease by improving arterial compliance, reducing LDL cholesterol oxidation, and when eaten with soy protein, reducing serum cholesterol levels.

Flavonoids, found in almost all fruits, vegetables, tea and wine, help boost intracellular activity that leads to the disposal of carcinogens, promote enzyme detoxification and reduce cellular proliferation. Flavonoids reduce the oxidation of cholesterol in the arteries, inhibit blood clot formation and enhance anti-inflammatory action. They have been associated with reduced risk of heart disease, stroke and COPD.

Other Protective Factors of Plant Foods

Fiber

Fruits, vegetables, whole grains, legumes, nuts and seeds are also major sources of fiber. *Insoluble* dietary fiber, also known as "roughage," is thought to protect against colon cancer and diverticulosis by increasing fecal bulk and decreasing transit time through the digestive tract. *Lignans* are phytoestrogens that are produced by bacterial fermentation of components found in insoluble fiber from flaxseed, sesame and sunflower seeds, and whole grains. *Soluble* fiber, found in legumes, oat bran, fruits and vegetables, may help to control serum cholesterol levels by binding with bile acids, thus increasing cholesterol degradation and excretion.

Folic Acid

Folic acid has been shown to help lower blood homocysteine, a known risk factor for cardiovascular disease. Folic acid also prevents deficiencies, which could lead to chromosomal damage thought to be related to the development of certain cancers and birth defects.

Potassium

Clinical trials have shown that diets high in fruits and vegetables (8 - 10 servings per day) helped to reduce

blood pressure in individuals with and without hypertension. Potassium is suggested as the beneficial nutrient.

Nutrition Recommendations

Most scientific evidence supports the consumption of a predominantly plant-based diet. The American Institute of Cancer Research (AICR) and the National Cancer Institute recommend five or more servings a day of a variety of vegetables and fruits, particularly dark-green leafy, cruciferous and yelloworange vegetables, and citrus and deep yellow-orange fruits^{1,2}. AICR also recommends seven or more servings a day of a variety of cereals (grains), pulses (legumes), roots, tubers and plantains, preferrably minimally processed.

The mechanism that explains the health benefits from food is likely to be multiple in origin. More than 100 beneficial vitamins, minerals, fiber and other dietary components are estimated to be found in food. Large-scale adoption of a diet rich in plant foods, along with low-fat meat and dairy products has been shown to make significant improvements in the incidence of chronic diseases.

Supplements

The general consensus of health experts is to obtain nutrients from food sources rather than relying on vitamin, mineral or fiber supplements. Many phytochemicals have been identified in foods, but many remain to be found. It is believed that the variety of nutrients and phytochemicals found in food work in partnership to maintain cellular health. Actual reductions in disease risk are most likely related to a combination of dietary interactions that act synergistically to promote health. Supplements can provide nutrients and other physiologically active components in a potentially unbalanced and concentrated form that may be far different from the form found naturally in foods.

Conclusive data regarding the protection by individual food components against chronic disease in humans is not yet available. The Panel on Dietary Antioxidants and Related Compounds, charged with establishing the new Dietary Recommended Intakes (DRI) for vitamin C, vitamin E, selenium and carotenoids, could not establish recommended levels of intake for the prevention of chronic diseases due to the limited scientific data. The Panel would not classify carotenoids as "dietary antioxidants" due to the lack of evidence of carotenoid functions in humans³.

Supplementation with individual nutrients, such as

vitamin C, vitamin E or beta-carotene have not demonstrated the beneficial effects associated with following a diet rich in vegetables, fruits and legumes⁴. In fact, supplements in large doses may be harmful to health. A large study involved synthetic beta-carotene supplementation of 20 mg per day for a 5 to 8 year period in male smokers. The results showed an 18% increased risk in the incidence of lung cancer⁵. In the Iowa Women's Health Study, those who consumed high intakes of vitamin E in their diets had a reduced risk of heart disease, but women who obtained vitamin E from supplements had no decreased risk of heart disease⁶. Phytoestrogens may elicit an estrogenic response, stimulating cell proliferation and increasing the risk of cancer. Women with estrogen-responsive breast cancer should be cautious about taking phytoestrogen supplements or high intakes of soy food⁷.

Diet and physical activity have been proven to significantly reduce the risk of chronic disease. No single nutrient, or combination of nutrients, will ever replace the benefits of a healthy overall lifestyle.

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